A SCENARIO FOR THE DEPLOYMENT OF HTRs TYPE GTMHR USING REACTOR-GRADE PLUTONIUM

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AIM OF THE STUDY

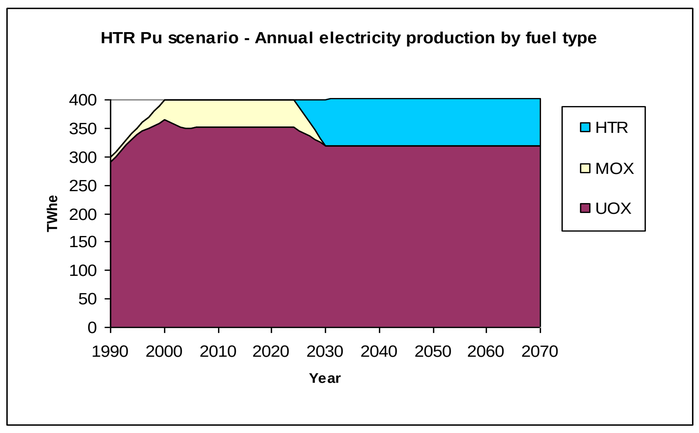
What would be the performances of a nuclear park composed of LWRs and HTRs with Plutonium fuel with regard to the plutonium management ?

MAIN ASSUMPTIONS

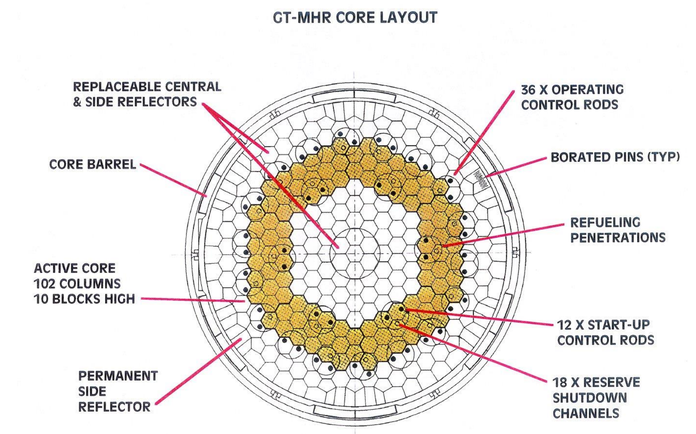
The resources in natural Uranium are sufficient to feed a nuclear park with LWR during the XXIth century. The deployment of the fast reactors can be delayed and the stabilization of the inventory in nuclear materials, and particularly Plutonium, becomes necessary. In this case, the deployment of HTR type GTMHR using fuel with Plutonium gives the possibility to stabilize the Plutonium inventory in the nuclear park

ASSUMPTIONS

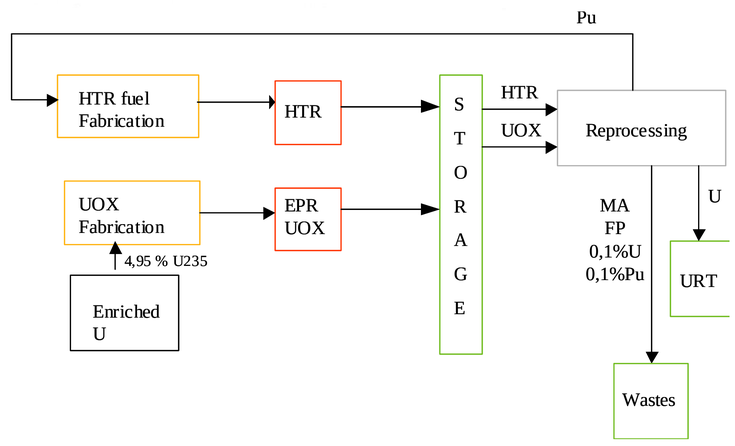
1 – The context is the continuation of nuclear energy in France. the renewal of the current nuclear fleet will start in 2020, with EPR and also HTR. The mono recycling of Plutonium in the LWR is stopped in 2025, so as to keep the Plutonium for the HTR.



2 - The reactor core of the HTR consists of 102 prismatic block-type fuel assemblies surrounded by internal and external graphite reflector. Standard/control fuel assembly contains 216/174 fuel compacts and 108 Helium channels. The fuel is made of $PuO_{1.8}$ TRISO particles (ϕ_{fuel} = 200 µm, $\phi_{particle}$ = 630 µm). Thermal power is 600 MW.

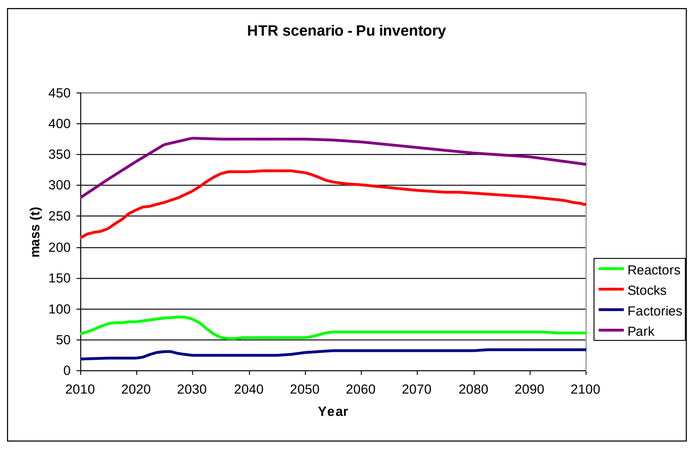


3 – The calculation of the scenario have been performed with the code COSI. This code simulates a pool of nuclear electricity generating plants with its associated fuel cycle facilities. In COSI, the CESAR code is used for the in-pile calculations. CESAR uses cross sections generated after neutronic calculations performed with the APOLLO2 code



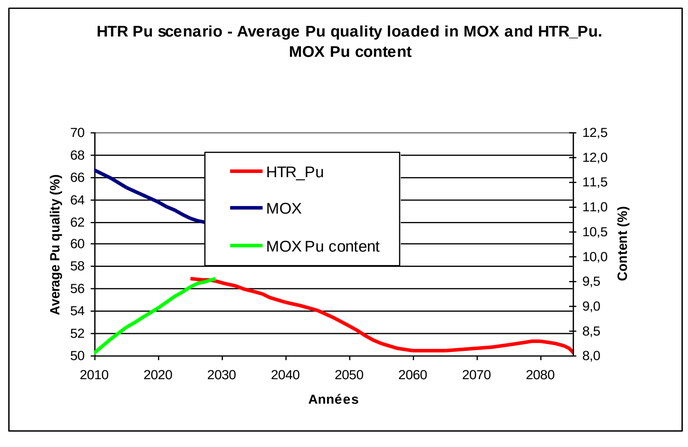
RESULTS

1.The results demonstrates the capacity of the HTR using Plutonium to decrease the Plutonium inventory in the park. However, the number of HTR necessary to decrease the french Plutonium inventory is equal to 42.



2.Due to the decrease of the quality of the Plutonium in the HTR, the quantity of Plutonium available for the HTR fresh fuel decreases continuously. As a consequence, this scenario cannot be extended after 2080.

3.Compared to the open cycle, the monorecycling of the Plutonium in the PWR or in the HTR produces more minor actinides (resp. +8,8 % and + 13,8%).



CONCLUSION

HTR with Plutonium fuel can be considered as a transition solution for the management of the plutonium.